attitudes of rest in British moths, predaceous insects and their prey. A subject like the last, for instance, worked out by the cooperation of many naturalists, commends itself as zoological work of the soundest sort; it brings together a mass of trustworthy information in regard to insect natural history, it has an obvious bearing on the theory of selection, and it makes towards supplying a trustworthy basis for practical measures. Three of these interesting bionomical memoirs are contributed by Dr. F. A. Dixey, two by the Hope professor, and one each by Messrs. T. R. Bell, A. H. Hamm, S. L. Hinde, W. J. Kaye, and S. A. Neave. Three papers by Dr. Longstaff contain records of observations—chiefly bionomic —on insects met with in various parts of the world. Then follow papers, chiefly of a systematic nature, on Blattidæ by Mr. R. Shelford, on "grasshoppers" by Dr. J. L. Hancock, on beetles by Commander J. J. Walker. After these the volume ends, as it began, with bionomical inquiry, from which modern entomologists are seldom far away. We cannot look over a volume like this (reviving our recollections, in some cases, of papers we had read before) without feeling afresh that the entomologist, more, perhaps, than most naturalists, has his finger on the pulse of evolution. The Hope Reports show that he is not unaware of his great opportunities.

Calcul graphique et nomographie. By M. d'Ocagne. Pp. xxvi+392+xii. (Paris: Octave Dion, 1908.) Price 5 francs.

THE "Encyclopédie scientifique" of which this book forms one volume is intended ultimately to consist of 1000 volumes divided into 40 sections, written by specialists in different sciences, and edited by Dr. Toulouse. While aiming at the completeness of an encyclopædia, it differs from most publications bearing that name in that it consists of small volumes, each treating of one subject, instead of bulky volumes, each containing a number of widely diverse articles.

In this volume M. d'Ocagne deals with graphical methods of computation, a subject in the development of which he has himself played an important part. It is pointed out that such methods are sufficiently accurate for the solution of most problems, financial calculations and certain geodetic operations constituting an exception, though even in these graphic methods may play an important part. The first part of the book deals with graphical algebra and graphic methods of integration, the second with nomography. The latter subject is treated from two points of view, between which a kind of principle of duality exists—the method of concurrent lines, and the method of collinear points. In the former the relation between three variables is determined by the intersection of the lines corresponding to constant values of the respective variables; in the latter three straight or curved lines are scaled, and the simultaneous values of the variables are represented by collinear points on the scales which can be read off by laying a ruler across them. In Prof. d'Ocagne's hands this method has effected quite a revolution in simplifying numerical approximations, and it has the merit of being easily extended to more than three variables.

Mythenbildung und Erkenntnis. By G. F. Lipps. Pp. viii+312. (Leipzig: B. G. Teubner, 1907.) Price 5 marks.

THIS is an interesting contribution to the literature which in recent times has been filling up the gap between mathematics and philosophy. In it the author traces the origin of mythical superstitions in primitive races and their subsequent replacement by the critical methods of exact analysis. He further discusses the application of symbolic methods to the representation of phenomena connected with the universe, with existence, and with thought. The book forms a suitable sequel to Poincaré's "Science and Hypothesis," and is published in the form of the third of a series of books bearing the title of Poincaré's volume. While covering a somewhat different field, Dr. Lipps's method of treatment is more constructive in character. He has attempted to build up a connected theory rather than to ask the invariable question, Why?

The Old Yellow Book. By Charles W. Hadell. Pp. viii+cclxii+345. (Washington: Carnegie Institution, 1908.)

THE first part of this large volume consists of a complete photographic reproduction of the "Yellow Book," now in the library of Balliol College, which formed the theme of Browning's poem, "The Ring and the Book." This is followed by an English translation, as well as translations of two other sources of information relating to the Franceschini murder case, and an essay by the author on "The Making of a Great Poem." The photographic reproductions, as the author points out, are of first importance to secure the scholarly world against the possible destruction of the unique copy in Balliol College. At the same time, seeing that a few blemishes, due to creases in the original book, have been removed, and that the pages have been re-numbered, it seems a pity that the present book was not properly guillotined before being issued to the public.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On the Magnetic Action of Sun-spots.

IT was perhaps to be expected that the recent discovery of the Zeeman effect in the spectra of sun-spots should revive the idea of a direct magnetic action originating in the sun and observable at the surface of the earth. A numerical estimate is therefore called for as to the magnitude of the disturbance which might be produced by such a direct action.

A solar vortex involving electric circulation, and consequently magnetic fields, will be most favourably placed to produce magnetic action if its apparent position is at the centre of the solar disc. If we consider the disturbed area, which for convenience I shall call the spot, as a magnetic pole, the first question that arises refers to the whereabouts of the opposite pole. We may place it at the further end of the solar diameter passing through the spot, and thus again assume the most favourable conditions. If, now, the vertical forces on the solar surface are treated as made up of a series of spherical harmonics, we need only consider the first term from which forces varying inversely as the cube of the distance are derived, because the numerical values of the forces derived from the higher terms are, at the distance of the earth, at least a hundred times weaker. Write, therefore, for the vertical force F

$$F = B\mu + \text{higher terms},$$

where μ is the cosine of the solar co-latitude measured from the spot.

The coefficient B is determined in the usual way by

$$\int_{-1}^{+1} F\mu d\mu = \tfrac{2}{3}B.$$

As the spot is confined to a small region, for which $\mu = 1$, and F has only finite values over this region and at the opposite pole, we may for the left-hand side of the

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equation substitute $2Fa$, where a is the area of the spot measured in terms of the solar hemisphere. This leads to

$$B = 3Fa.$$

The vertical force will not be constant over the whole spot area, but we may now take F to be the average vertical force, and its variations are immaterial when it is only a question of evaluating the order of magnitude of the effect. At the distance of the earth the corresponding force acting in a direction radial from the sun is equal to $3Fa\alpha^3$, where α is the angular semi-diameter of the sun as viewed from the earth ($\alpha^3 = 10^{-7}$).

If we adopt Zeeman's estimate of 3000 C.G.S. for F, the only remaining quantity to be estimated is a. We may take account of the greatest possible collective effect of all spots by imagining them all of the same polarity and placed at the centre of the solar disc; a then represents the total spotted area which may be obtained by reference to the Greenwich tables. If we include in the spot area the penumbra as well as the umbra, we find the average value to be about 500 in millionths of the sun's hemisphere, but in years of sun-spot maxima this number will be considerably exceeded. Taking the year 1893, which was the most prominent sun-spot year since 1870, I find that on August 7 the value of a was 5128 in the above units. Writing 0·005 for a, the radial solar force is found from the above expression to be $4\cdot5 \times 10^{-6}$ C.G.S. On the Greenwich curves such a force would be represented by a displacement of one-tenth of a millimetre.

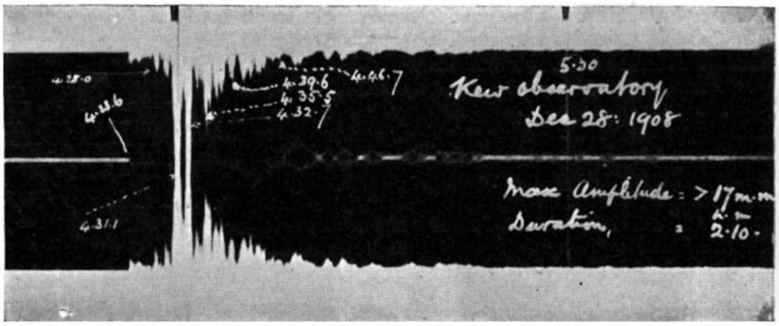

FIG. 1.

The magnetic fields on the sun, on which our calculations are based, cannot, of course, form or disappear suddenly, and in view of the smallness of the effect the only question that can arise is whether, if persistent for a sufficiently long time, periodic variations might just be traceable. Some years ago I worked out in full the periodic effects of a magnetised and rotating sun (*Phil. Mag.*, vol. xlvi., p. 395, 1898). The main periods introduced are two, one of twenty-nine days, if the synodic revolution of the sun is twenty-seven days, and one equal in length to the sidereal day. (The period of twenty-seven days drops out altogether.) As regards the former period, it could only show itself if the magnetic state of the sun persisted for a sufficiently long period, and would probably even then escape detection owing to its smallness.

Similarly, the sidereal period would be hidden behind that of equal period and much larger amplitude which is introduced by the seasonal fluctuation of the ordinary diurnal period; but we need not enter into a detailed discussion of the possibility of tracing minute effects. My main object has been to show that the magnetic disturbance hitherto associated with the state of the sun's surface cannot be accounted for by the direct magnetic action of Prof. Hale's electric vortices.

ARTHUR SCHUSTER.

Kew Records of the Italian Earthquake.

THE accompanying traces show records of the Italian earthquake of December 28, 1908, given by the Milne seismograph and the declination magnetograph respectively at Kew. The former shows a very sudden arrival of seismic waves of some magnitude at 4h. 23·6m. a.m. (G.M.T.). If these represent "preliminary tremors" from an earthquake originating in Italy, about 2000 kilometres away, one would expect the large waves not to commence until some seven minutes later. Ordinarily, the maximum amplitude occurs some little time after the large waves commence. In the present case, however, the maximum is shown at either 4h. 31·1m. or 4h. 32·7m., the lateral traces overlapping at both these times. This means a movement of more than 17 mm. at the end of the boom.

It is unusual for the Kew magnetic curves to show any record whatever of earthquakes. On the few past occasions when the magnetic traces have shown anything, it has taken the shape of a burr of vague outline, indicating that the magnets have been put in oscillation. (Ordinary magnetic changes are not discontinuous, and for these the magnets are practically dead-beat.) The present occasion is, I think, unique in that not one, but several, of these burrs are distinctly visible in the original declination curve, though in a copy they will, I fear, be indistinct. The time scale is only 15mm. to the hour, and an uncertainty of at least 0·5 minute must be allowed in estimates of time. To prevent prejudice, the four burrs distinctly seen were measured prior to an inspection of the Milne trace, and the times allotted were respectively 32, 36, 40, and 47 minutes after 4 a.m. These answer apparently to the seismic movements of which the measured times are 32·7 (or 31·1?), 35·5, 39·6, and 46·7 minutes after the hour. The original declination trace shows a distinct movement at 4·27, but this is of a different type, and may not be of seismic origin. There is also at 4·23 or 4·24 a very faint suggestion of movement. This may answer to the commencing seismic movement, but, unlike the other movements on the declination trace, it was not noticed until after the Milne record had been examined, and it should be regarded as doubtful.

The horizontal-force curve showed only one conspicuous burr, the measured time for which was 4·33. For some time prior to 4·23 the edge of the declination curve was pretty sharp, and apparently no disturbance existed. Any magnetic effect originating at the seat of the earthquake should have affected the Kew magnets several minutes in advance of the earliest seismic record. Thus in this case, at least, the movements shown on the magnetic curves are of purely mechanical origin—the magnetograph acting as a seismograph—or else they represent some magnetic effect arising in the near neighbourhood on the arrival there of the earthquake waves.

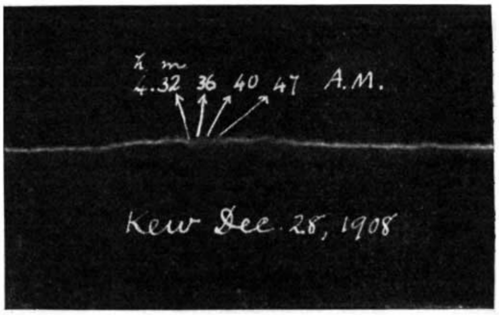

FIG. 2.

The periods of the declination and horizontal-force magnets and of the Milne boom are respectively about $10\frac{1}{2}$, $13\frac{1}{2}$, and $17\frac{1}{2}$ seconds, and as recorders of earthquakes

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